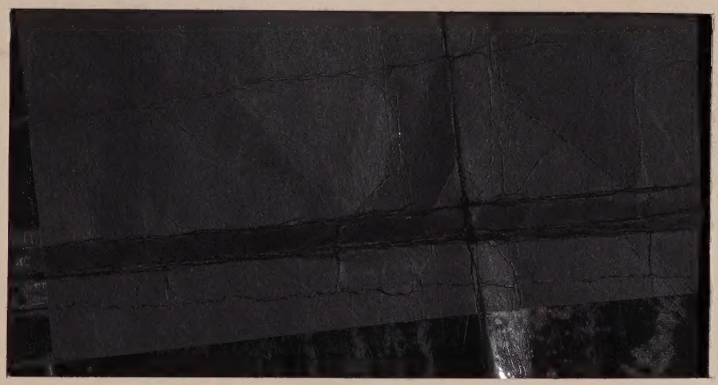

ac-dc power supplies

BEHLMAN-INVAR ELECTRONICS CORP.
1723 CLOVERFIELD BLVD.
SANTA MONICA, CALIF.

REPRESENTATIVES IN ALL PRINCIPAL CITIES AND CANADA

EX 3-9611 • UP 0-9346 • TWX SMON-7098

MANUAL
OPERATIONAL - MAINTENANCE

MODELS: TP AND TPA SERIES
DC POWER SUPPLIES

Publication No. 9689

NOTICE:

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BEHLMAN-INVAR ELECTRONICS CORP.
1723 CLOVERFIELD BOULEVARD
SANTA MONICA, CALIFORNIA
EXbrook 3-9611 TWX S. MON. 7098

October, 1962

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SECTION I
INTRODUCTION AND DESCRIPTION

1-1. GENERAL.

Behlman-Invar Electronics Corporation, who have pioneered many of the more important advancements in the field of transistorized power supplies, are pleased to submit this instruction manual for the Model TP and TPA Series power supply units, Dash 2, 5, 10, 15 and 30 Models.

These models are precision transistorized power supplies which operate from 105/125 volts ac at 55/65 cps line voltage, and deliver a precisely regulated dc output. (See Paragraph 1-7, Electrical Specifications.) These units may be used in the laboratory or incorporated in other electronic equipment as a source of high quality, fully regulated dc power.

1-2. PURPOSE.

To provide power supplies under design criteria conforming to the latest state of the art.

To provide an operational and instruction manual containing complete information for assistance when using the units.

1-3. WARRANTY.

Seller warrants the end product of its design and construction to be free from defects in material and workmanship. Any component parts other than vacuum tubes, fuses, blower motors, indicating lamps, and other indicating devices (except as warranties on these items are passed on to the seller by its suppliers), which become defective during the first year after shipment will be replaced free of charge by the seller, provided that the instrument is returned with transportation charges prepaid by the original purchaser and that our examination discloses to our satisfaction that the instrument is defective, but if the apparatus is installed, or its installation supervised, by the seller, said year

shall run from the completion of the installation, provided that same is not unreasonably delayed by the buyer.

The condition of any tests shall be mutually agreed upon, and the seller shall be notified, and may be represented at, all tests that may be made. The liability of the seller to the buyer (except as to title) arising out of the supplying of the said apparatus, or its use, whether on warrant, contract, or otherwise, shall not in any case exceed the cost of correcting defects in the apparatus as herein provided, and upon the expiration of said year all such liability shall terminate.

The foregoing shall constitute the sole remedy of the buyer, and the sole liability of the seller.

1-4. PREPARATION FOR USE AND RESHIPMENT.

Unpack the instrument with care and inspect it for any damage which it may have incurred in transit. If there is any damage, or if the unit fails to operate properly in accordance to instructions (see Paragraph 2-7), a claim should be filed with the carrier, with a copy of the Claim Agent's report being forwarded to Behlman-Invar Electronics Corporation.

On packaging for reshipment use adequate shock-absorbent material within the carton to prevent the instrument's sharp corners from protruding which would result in unit damage.

NOTE: DO NOT RETURN THE INSTRUMENT TO THE FACTORY WITHOUT PRIOR AUTHORIZATION FROM BEHLMAN-INVAR ELECTRONICS CORPORATION.

1-5. QUALITY CONTROL AND INSPECTION.

Behlman-Invar Electronics Corporation functions under a company-wide quality assurance program which insures that our customer receives equipment manufactured to the most exacting standards. This quality assurance system is based on the best commercial practices augmented by policies and procedures required under MIL Q-9858

1-6. SAFETY NOTES.

WARNING

Operation of the Behlman-Invar power supplies involves the use of high voltage. Use EXTREME CAUTION when any internal adjustments or tests are being performed.

CAUTION

When remote sensing is not used, VERIFY that the REMOTE SENSE shorting jumpers are correspondingly installed on the Connectors J2 and J3, J4 and J5, to avoid damaging the unit. (See Schematic, Figure A-1, Note B.)

1-7. ELECTRICAL SPECIFICATIONS.

The following tabulation lists the electrical characteristics for the TP and TPA Series power supplies (5 each).

	Output dc		Regulation %		Ripple	Output Z		Transients	
Model	E (v dc)	I (amps)	Line	no load to full load	mV rms max.	ohms dc	ohms 100 kc	±10% line	Recovery time no load to full load μsec. max.
Dash-2	0-36	2	10	5	0.6	0.002	0.1	None	20
Dash-5	0-36	5	10	5	0.5	0.001	0.1	None	30
Dash-10	0-36	10	10	5	0.5	0.0005	0.1	None	50
Dash-15	0-36	15	10	5	0.5	0.0003	0.1	None	75
Dash-30	0-32	30	10	5	1.0	0.0002	0.1	None	100

TABLE 1-1.

Input Line Voltage For All 5 Models: 105/125v ac at 55/65 cps, single phase.

Remote Sensing: Remote sensing is provided so that the selected output potential is maintained across a remote load despite a nominal line drop (due to their length) in the interconnecting cables.

Short Circuit Protection: Unit is capable of being shorted continuously without damage. Turning on the unit while the output or remote load is shorted causes no damage, and when the short is removed the voltage and current return to preset values.

1-8. ENVIRONMENTAL SPECIFICATIONS.

F1: Fuse located on the rear of the chassis and inserted in the ac input to the supply.

F2: Fuse located on the rear of the chassis and inserted in the raw dc output of the supply.
(See Schematic of respective models - Fig. A-1).

Operating Temperature: 0° to 50° C.

1-9. MECHANICAL SPECIFICATIONS.

Model	Width	Height	Depth	Weight
Dash-2	19"	5-1/4"	10"	30
Dash-5	19"	5-1/4"	13"	40
Dash-10	19"	5-1/4"	15"	51
Dash-15	19"	5-1/4"	20"	72
Dash-30	19"	7"	20"	100

TABLE 1-2

Mounting:	All units may be mounted on a standard 19" relay rack panel.
Terminals:	Front and rear-mounted terminals are incorporated which provide J1 through J9. (For functions see Schematic, Figure A-1.)

1-10. APPLICABLE DOCUMENTS.

Design Control:	Behlman-Invar Drawing Numbers as follows:
Dash - 2:	001A-0095
Dash - 5:	002A-0095
Dash- 10:	003A-0095
Dash- 15:	006A-0095
Dash- 30:	009-0095

SECTION II
PRINCIPLES OF OPERATION AND INSTRUCTION

2-1. DESIGN OBJECTIVE.

The design parameters of the Model TP and TPA Series power supply contribute to their operation in the following manner:

a. Provide a dc power supply fully regulated that is variable from 0 to 36v as specified in the electrical specifications. (See Paragraph 1-7.)

b. Provide high efficiency operation by allowing only a minimum of internal wattage dissipation regardless of output load conditions.

c. Provide fully rectified, filtered and stabilized voltage for the regulation circuitry, transformer section, filter section and Zener diode section.

d. Provide a remote sensing function, permitting the output voltage to be regulated from the voltage sensed at the load end. This feature ensures that the output voltage at the load remains constant, within the regulation specifications, with a nominal line drop.

2-2. CIRCUIT THEORY OF OPERATION.

Input ac is supplied from J1, Pins 2 and 3, through S1 and DS1 to T1 and T3, the auto and auxiliary transformers, respectively.

The ac from T1 passes through Fuse F1 to T2, the step-down power transformer of the raw dc section of the power supply. For the TPA-2, the output of T1 is applied to the rectifier CR1 through CR4 and then filtered through the network of R41-1, R41-2, C1-1 and C1-2. For the TPA-5, TPA-10, TPA-15, and TP-30, the same theory applies with the exception that R41-1 and R41-2 network is deleted.

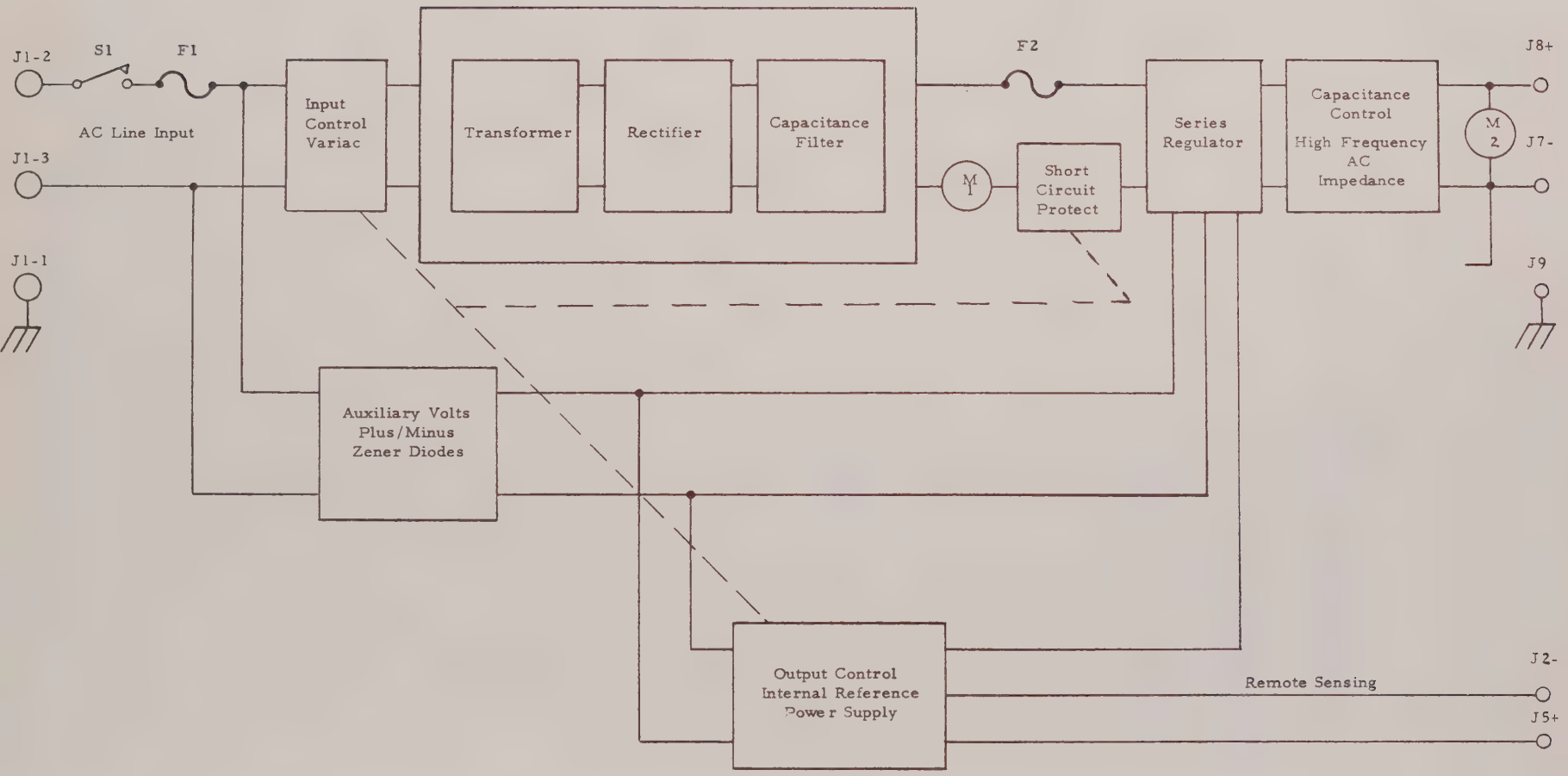


FIGURE 2-1. TP SERIES FUNCTIONAL BLOCK DIAGRAM

The raw dc is then fed through F2 being applied to the series regulator pass transistors Q10-1 and Q10-2, whose bases are driven by the power driver Q9 and the small signal Q8, whose bases are in turn being driven by the balanced amplifiers Q6 and Q7.

The power supply output voltage is sensed at the base of Q7 and compared with a very stable reference voltage developed across R27, the output coarse voltage control, and R26, the output fine voltage control.

2-3. INTERNAL REFERENCE SUPPLY.

The internal reference supply section, consisting in part by the transistors Q2, Q3, Q4 and Q5, and Zener reference diode Cr 12, is essentially in itself a small regulated dc supply, whose purpose is to furnish a highly regulated comparison voltage to the base of Q6.

2-4. AUXILIARY SUPPLY.

Raw dc being furnished to the internal reference supply (See Paragraph 2-3) is obtained from the auxiliary supply section and fed from Transformer T3 to the rectifiers CR5 through CR8, then passing through the filtering network of R1, R2, C2, and C3. Zener diode CR9 furnishes the minus output voltage and CR10 furnishes the plus output voltage for the auxiliary supply.

2-5. SHORT CIRCUIT PROTECTION.

The maximum output current adjust section and short circuit protection consist of Transistor Q1 and Potentiometer R17.

A reference voltage of approximately one volt is established at the emitter of Q1 by the diode CR11 and the dropping resistors R7 and R8. As the current increases through R17 a voltage drop occurs which is tied to the base of Q1 through the potentiometer R16. As this voltage reaches and exceeds the emitter reference voltages, Q1 is turned on. The collector of Q1 is tied through R11 to the base of the small signal driver Q8, thus when Q1 is turned on Q8's base is grounded and current decreases.

In order to obtain the current cutback feature of our short circuit protection the reference voltages of the emitter of Q1 is lowered as the output voltage drops in short circuit and requires less current through R17 to maintain cut-off in the pass transistor.

2-6. CONTROLS.

a. OUTPUT VOLTAGE COARSE, ganged mechanically with R7, R27, and T1, auto transformer, located on the front panel.

b. OUTPUT VOLTAGE FINE, for R26, located on the front panel.

c. MAXIMUM CURRENT ADJUST. for R17, located on the front panel.

d. J1, power input Jones plug, located on the rear of the chassis.

e. S1, toggle switch for ac line input, located on the front panel.

f. DS1, amber "AC ON" indicator light, located on the front panel.

g. M1, 0 to 3 ammeter, located on the front panel.

h. M2, 0 to 40v dc voltmeter, located on the front panel.

i. J2, J3, J4, J5 and J6, located on the rear of the chassis. (For function see Schematic, Figure A-1.)

j. J7, J8 and J9, located on the front panel. (For function see Schematic, Figure A-1.)

2-7. OPERATIONAL PROCEDURES.

a. CONNECT: AC line to J1.

b. ACTIVATE: S1 to the "ON" position.

c. MONITOR: DS1 for "ON" indication.

d. ADJUST: Fine and coarse output voltage controls for the desired voltage.

e. ADJUST: Maximum current control for the desired current flow.

f. MONITOR: M1 and M2 for the desired readings.

SECTION III

MAINTENANCE PROCEDURES

3-1. MAINTENANCE AND TROUBLE SHOOTING.

The power supply does not require any periodic maintenance other than cleaning to remove excessive dust and dirt. If it is necessary to replace components, use only first quality commercial components of values and types indicated. No selected components are used. When replacing components or trouble shooting, observe "warning" (See Warning Notice, Paragraph 1-6) since dangerous voltages may exist in the power supply. If it is ever necessary to replace the variable autotransformer or either of the two potentiometers connected to the variable autotransformer by means of the gear chain, the following check should be used to insure that the gearing is correct. With the coarse output voltage control turned completely counterclockwise, the variable autotransformer T1 and the potentiometers R7 and R27 should be positioned in the same manner.

3-2. TROUBLE SHOOTING PROCEDURES.

a. SYMPTOM: No output voltage.

POSSIBLE CAUSE: Fuse blown.

REPAIR PROCEDURE: Check for damaged rectifiers or shorted input capacitors or transformer, before replacing ac fuse. If dc fuse is blown, then check for possibility of overheating and short circuit. Remove short circuit.

b. SYMPTOM: Poor load regulation.

POSSIBLE CAUSE: Maximum output current adjust potentiometer set at too low a value.

REPAIR PROCEDURE: Set potentiometer to proper maximum current setting. This is about 20% higher than the desired maximum current.

c. SYMPTOM: Poor regulation and output cannot be reduced to zero by output voltage control.

POSSIBLE CAUSE: One of the series regulating transistors, Q10-1 or Q10-2 on the heatsink, or Q9, on the board next to the heatsink, or Q2, on the main component board, is shorted.

REPAIR PROCEDURE: Replace transistor. To determine which transistor is shorted, open the emitter of Q8. If the output voltage drops to zero (without load), transistor Q8 should be replaced.

d. SYMPTOM: Power transformer and variable autotransformer overheated.

POSSIBLE CAUSE: One or more of the rectifiers CR1 to CR4 are defective.

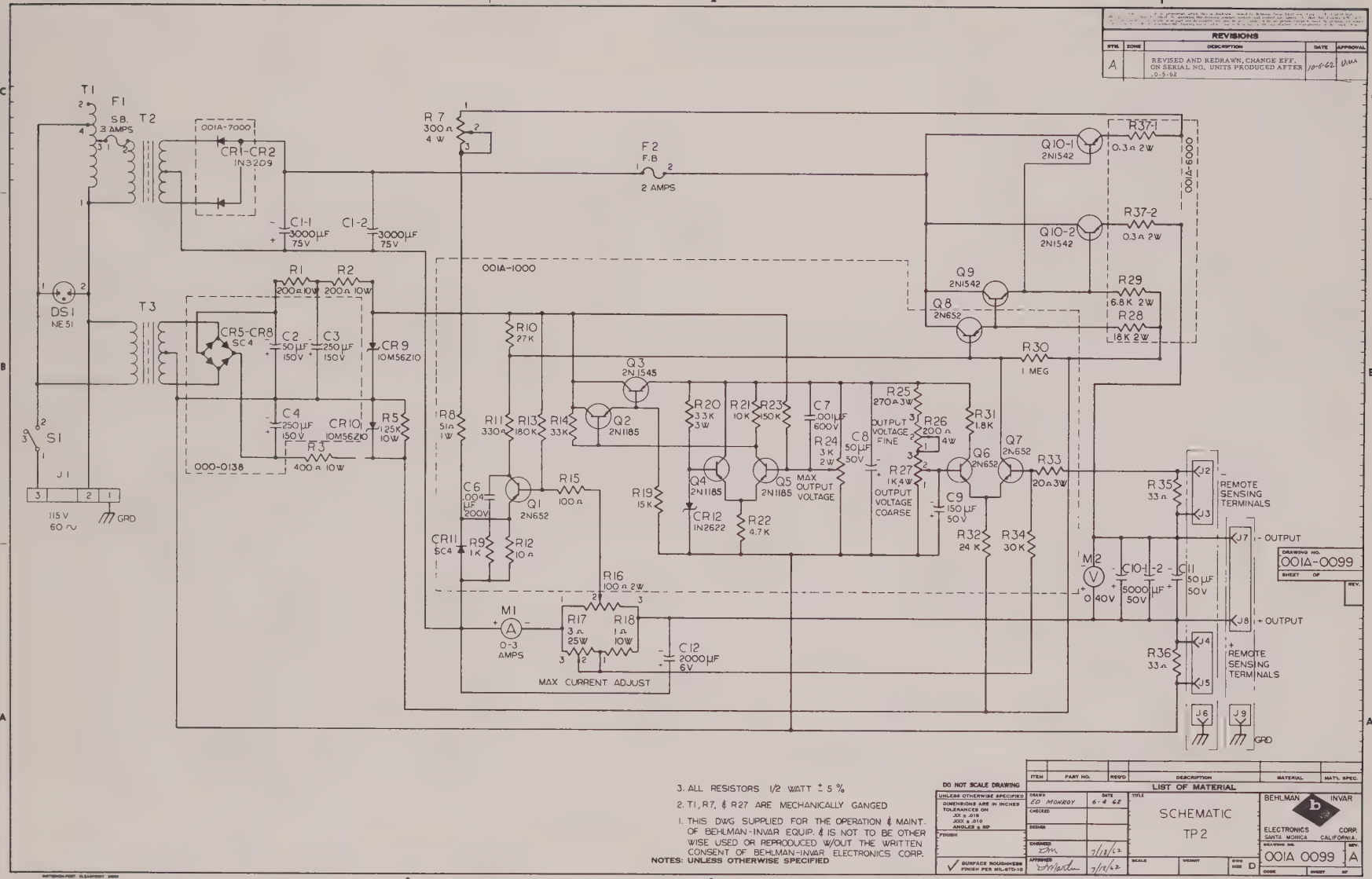
REPAIR PROCEDURE: Replace rectifier.

e. SYMPTOM: Output voltage floats erratically.

POSSIBLE CAUSE: Remote sensing jumpers not tightly connected, or, if remote sensing is being used, remote sensing leads not properly connected.

REPAIR PROCEDURE: Check sensing connections.

APPENDIX



3. ALL RESISTORS 1/2 WATT ± 5 %

2. T1, R7, & R27 ARE MECHANICALLY GANGED

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ITEM	PART NO.	REQ'D	DESCRIPTION	MATERIAL	MAT'L SPEC.

LIST OF MATERIAL

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES ON XX ± .015 XXX ± .010 ANGLES ± 30'

FINISH

SURFACE ROUGHNESS FINISH PER MIL-STD-10

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DESIGN		
ENGINEER	DM	7/18/62
APPROVED		7/19/62

TITLE: SCHEMATIC TP2

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BEHLMAN INVAR ELECTRONICS CORP. SANTA MONICA CALIFORNIA

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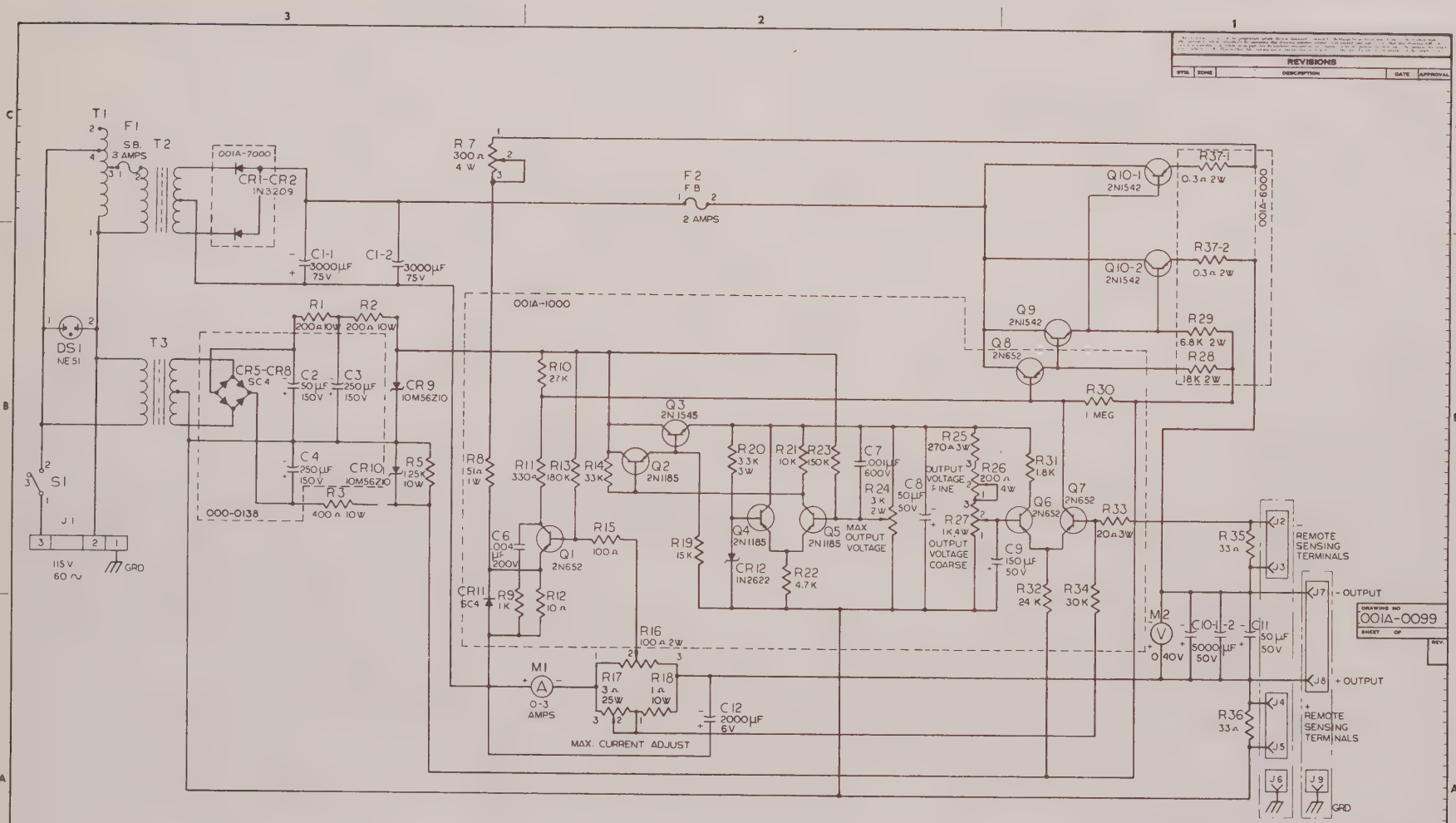

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STR.	ZONE	DESCRIPTION	DATE	APPROVAL

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FINISH

✓ SURFACE ROUGHNESS FINISH PER MIL-STD-10

ITEM	PART NO.	REQ'D	DESCRIPTION	MATERIAL	MAT'L SPEC.

LIST OF MATERIAL

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CHECKED		
DESIGNED	DM	7/13/62
APPROVED	[signature]	7/19/62

TITLE: SCHEMATIC TPA-2

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BEHLMAN INVAR ELECTRONICS CORP. SANTA MONICA CALIFORNIA

DRAWING NO. 001A 0099 REV.

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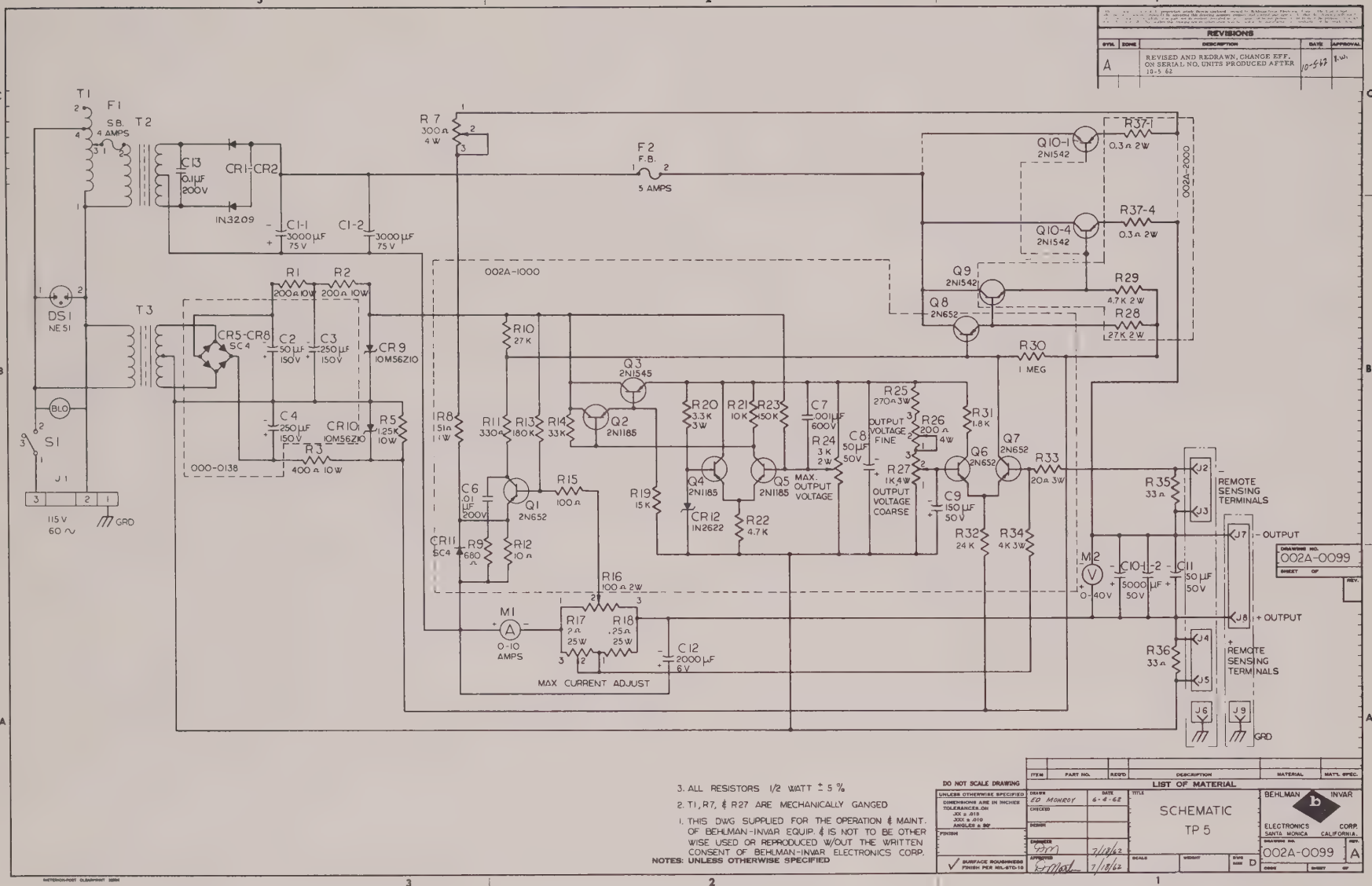

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2. T1, R7, & R27 ARE MECHANICALLY GANGED
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DIMENSIONS ARE IN INCHES
TOLERANCES ON
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.XXX ± .010
ANGLES ± 30'
FINISH
✓ SURFACE ROUGHNESS FINISH PER MIL-STD-10

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DESIGN	
ENGINEER	7/18/62
APPROVED	7/18/62

LIST OF MATERIAL

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SCALE | WEIGHT | DWG SIZE D

BEHLMAN INVAR
ELECTRONICS CORP.
SANTA MONICA CALIFORNIA

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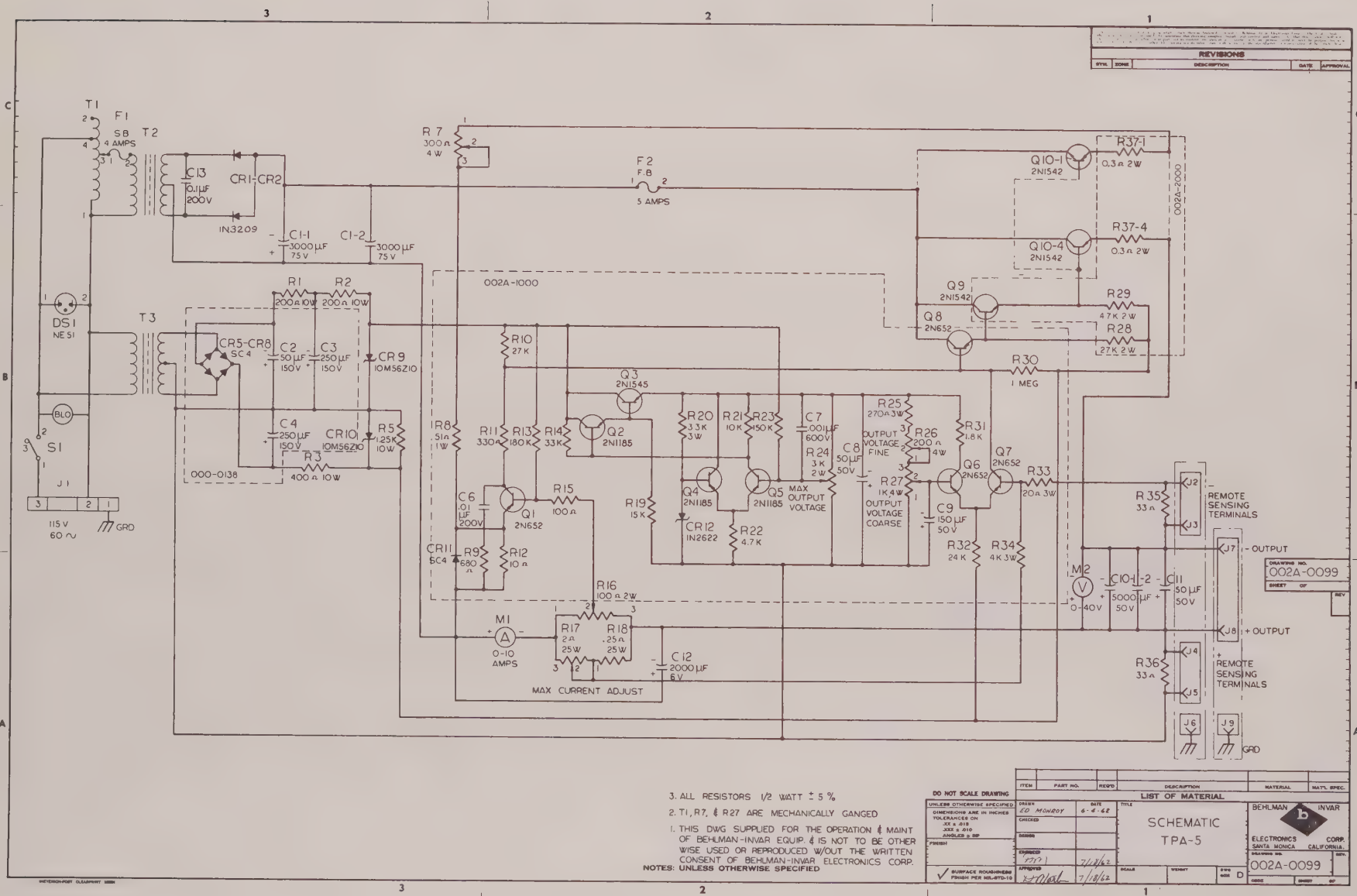
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SB
4 AMPS
T2
C13
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200 V
CR1-CR2
IN3209
C1-1
3000 µF
75 V
C1-2
3000 µF
75 V
R7
300 Ω
4 W
F2
F.B
5 AMPS
002A-1000
R1
200 Ω 10W
R2
200 Ω 10W
T3
CR5-CR8
SC4
C2
50 µF
150 V
C3
250 µF
150 V
CR9
10M56Z10
DS1
NE51
BLO
S1
J1
115 V
60 ~
GRD
C4
250 µF
150 V
CR10
10M56Z10
R5
1.25K
10W
R3
400 Ω 10W
000-0138
R10
27K
R8
51Ω
1W
R11
330Ω
R13
180K
R14
33K
Q3
2N1545
Q2
2N1185
R20
3.3K
3W
R21
10K
R23
150K
C7
.001µF
600V
R25
270Ω 3W
OUTPUT VOLTAGE FINE
R26
200 Ω
4W
R31
1.8K
C8
50 µF
50V
R24
3K
2W
MAX OUTPUT VOLTAGE
R27
1K 4W
OUTPUT VOLTAGE COARSE
Q6
2N652
Q7
2N652
R33
20Ω 3W
C9
150 µF
50 V
R32
24K
R34
4K 3W
C6
.01
µF
200V
Q1
2N652
R15
100 Ω
R19
15K
Q4
2N1185
Q5
2N1185
CR12
IN2622
R22
4.7K
CR11
SC4
R9
680
Ω
R12
10 Ω
R16
100 Ω 2W
M1
0-10
AMPS
R17
2 Ω
25W
R18
.25 Ω
25W
C12
2000 µF
6V
MAX CURRENT ADJUST
Q10-1
2N1542
R37-1
0.3 Ω 2W
Q10-4
2N1542
R37-4
0.3 Ω 2W
002A-2000
Q9
2N1542
R29
47K 2W
Q8
2N652
R28
27K 2W
R30
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M2
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C10-1-2
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50V
C11
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50V
R35
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R36
33 Ω
J2
J3
J4
J5
J6
J7
J8
J9
REMOTE SENSING TERMINALS
- OUTPUT
+ OUTPUT
REMOTE SENSING TERMINALS
GRD
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REV
3. ALL RESISTORS 1/2 WATT ± 5 %
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TOLERANCES ON
XX ± .015
XXX ± .010
ANGLES ± 30'
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SURFACE ROUGHNESS FINISH PER MIL-STD-10
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ENGINEER
APPROVED
7/18/62
7/18/62
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TPA-5
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SIZE D
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ELECTRONICS CORP.
SANTA MONICA CALIFORNIA
DRAWING NO. 002A-0099
REV
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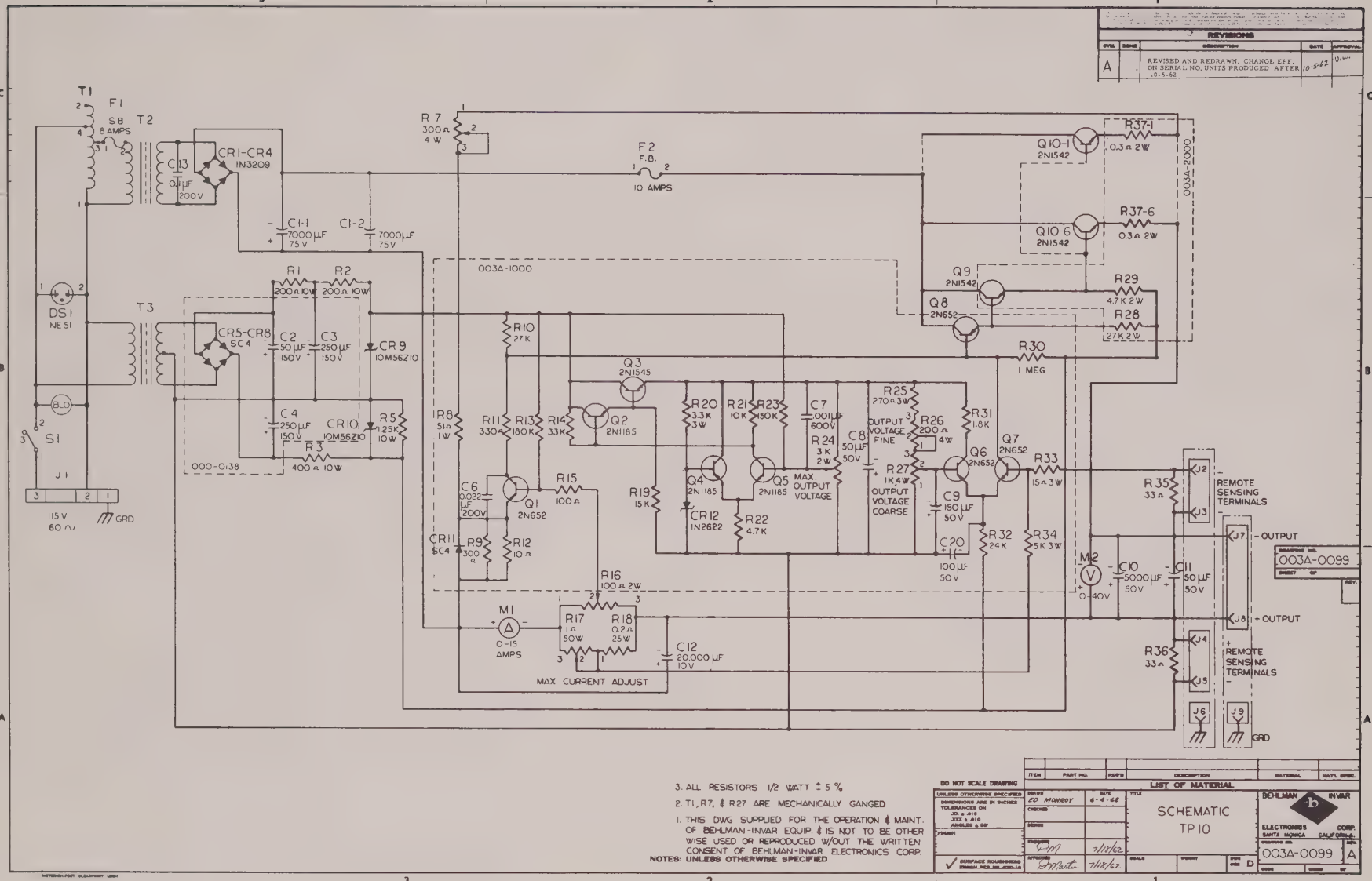

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FINISH

SURFACE ROUGHNESS FINISH PER MIL-STD-10

LIST OF MATERIAL

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DRAWN	
ENGINEER GM	7/11/62
APPROVED DMartin	7/18/62

SCALE

WEIGHT

SIZE D

TITLE SCHEMATIC TP10

BEHLMAN INVAR

ELECTRONICS CORP. SANTA MONICA CALIFORNIA

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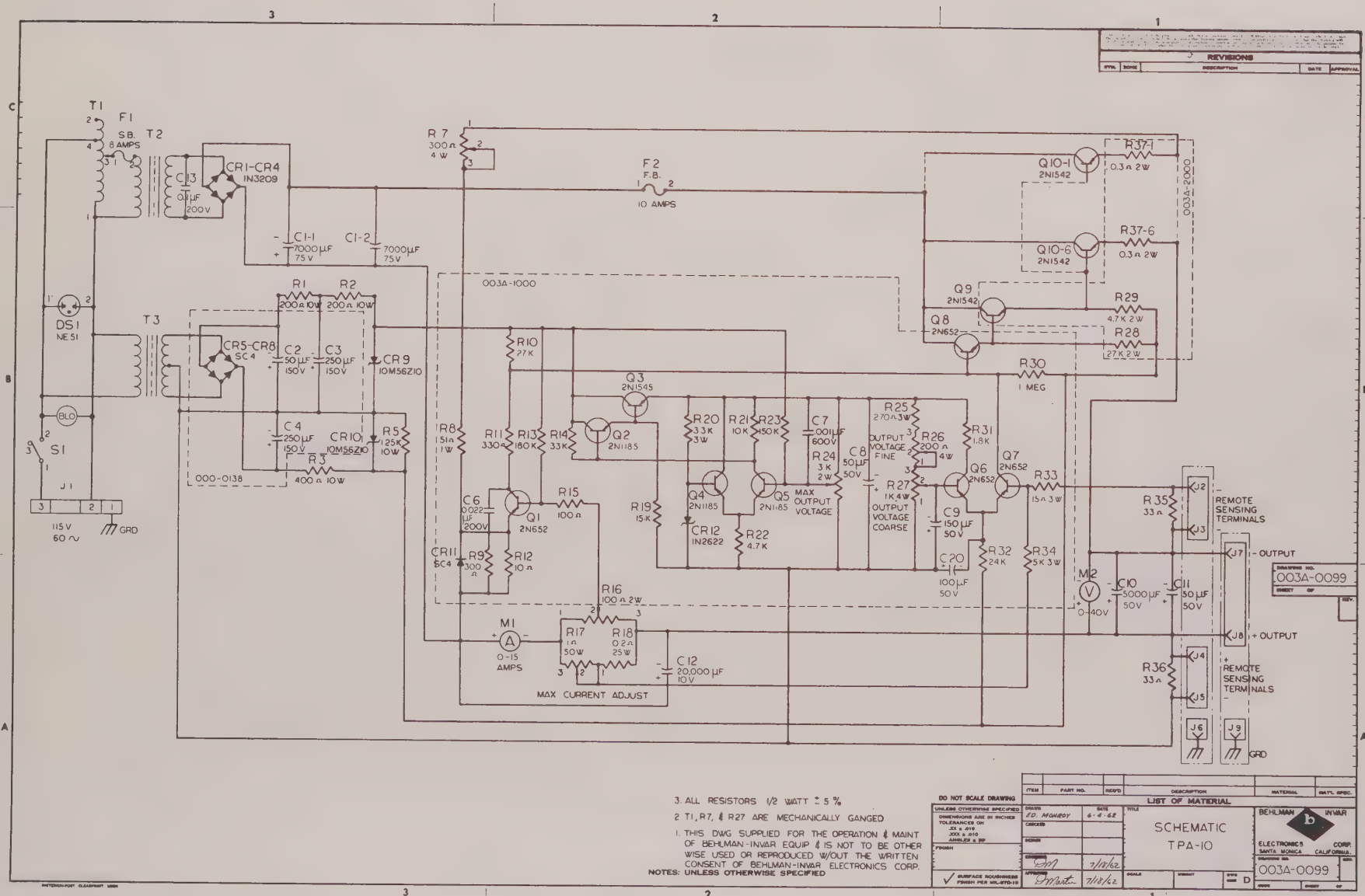
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T1
F1
SB. 8 AMPS
T2
CR1-CR4 IN3209
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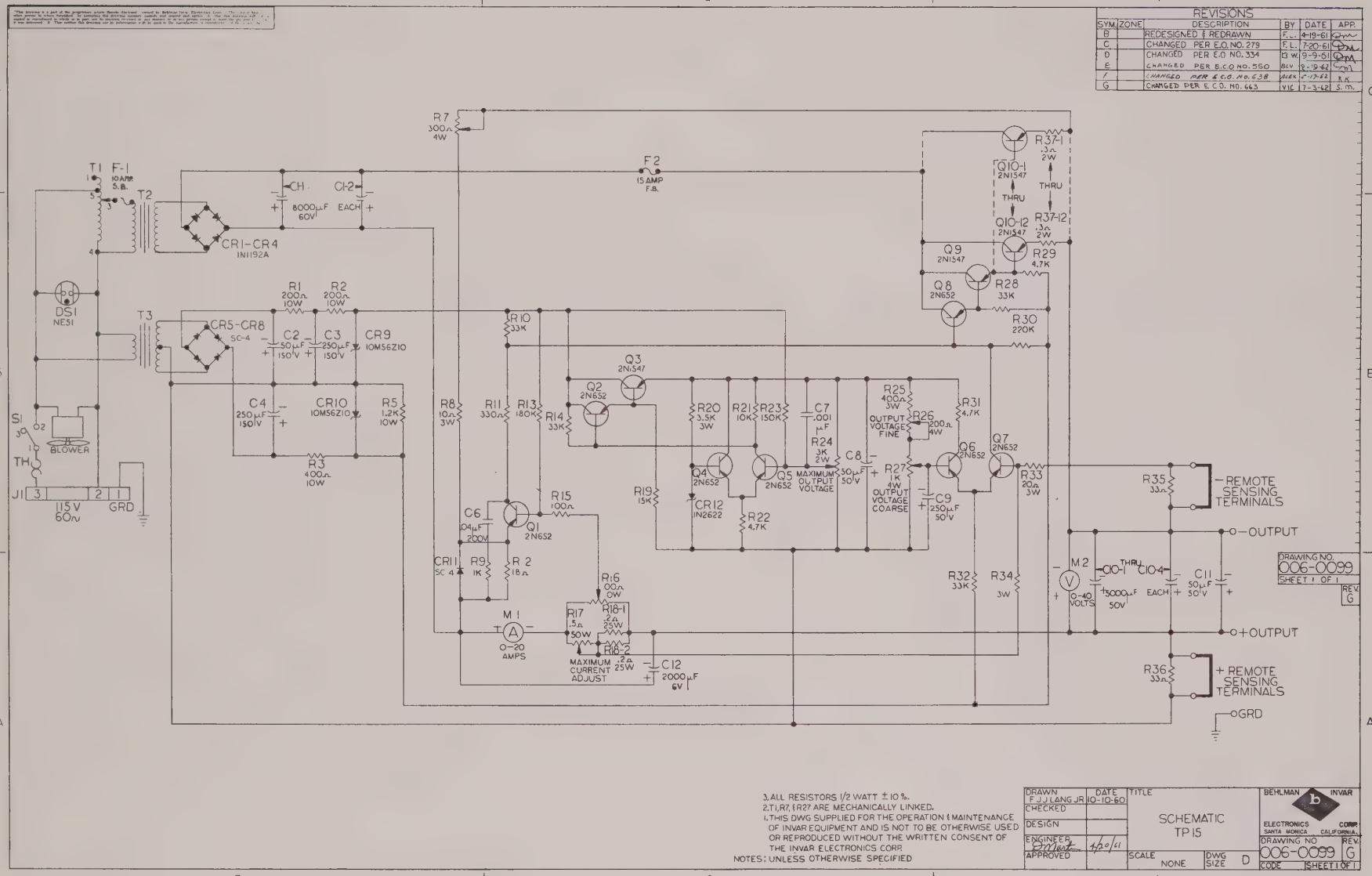
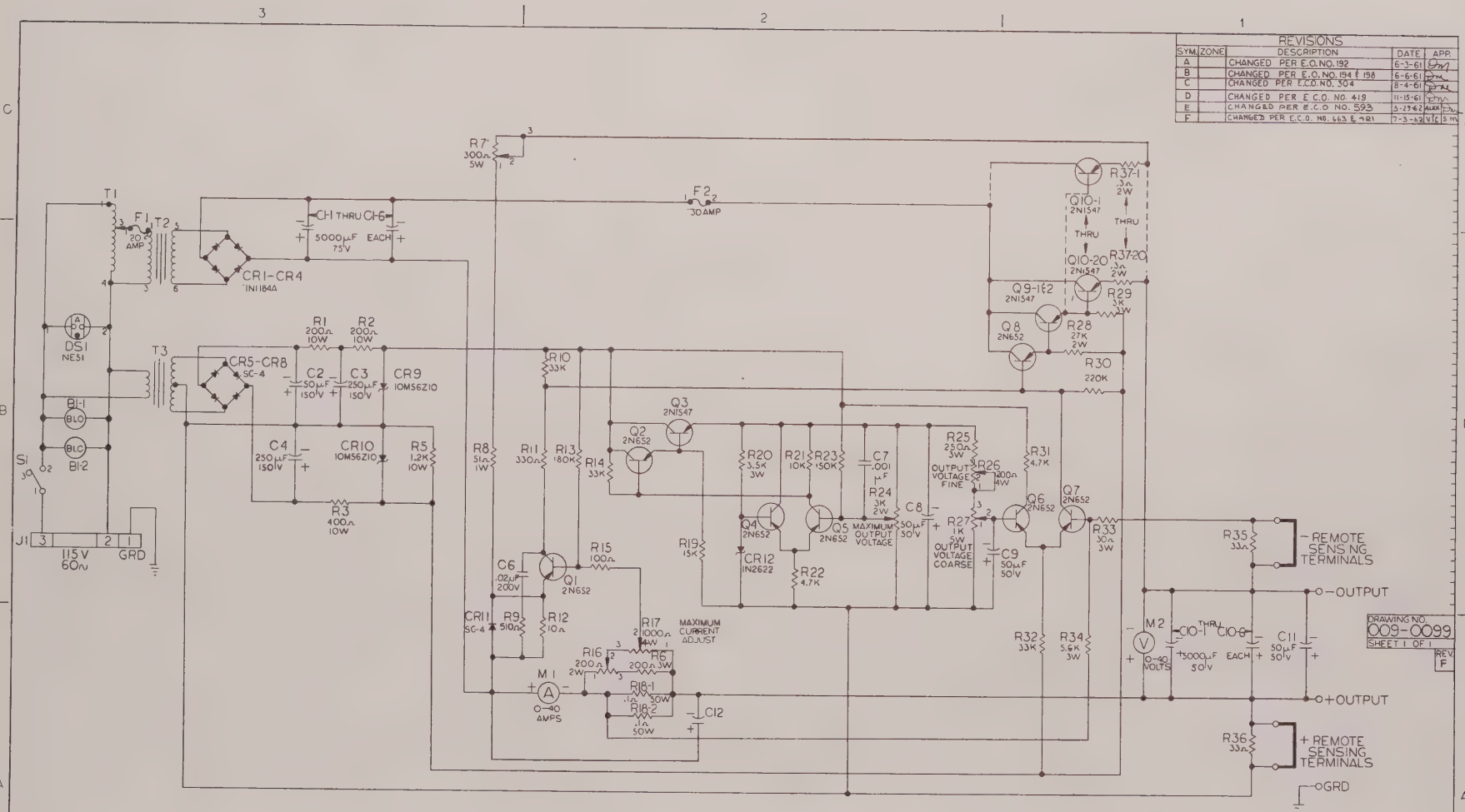
C1-1 7000 µF 75 V
C1-2 7000 µF 75 V
R7 300 Ω 4 W
F2 F.B. 10 AMPS
003A-1000
R1 200 Ω 10W
R2 200 Ω 10W
DS1 NE 51
T3
CR5-CR8 SC4
C2 50 µF 150 V
C3 250 µF 150 V
CR9 10M56Z10
C4 250 µF 150 V
CR10 10M56Z10
R5 1.25K 10W
R3 400 Ω 10W
000-0138
S1
J1
115 V 60 ~
GRD
R10 27K
Q3 2N1545
R8 51Ω 1W
R11 330
R13 180K
R14 33K
Q2 2N1185
R20 3.3K 3W
R21 10K
R23 150K
C7 .001µF 600V
R24 3K 2W
C8 50µF 50V
R25 270Ω 3W
OUTPUT VOLTAGE FINE
R26 200 Ω 4W
R27 1K 4W OUTPUT VOLTAGE COARSE
R31 1.8K
Q6 2N652
Q7 2N652
R33 15Ω 3W
C6 .022 µF 200V
Q1 2N652
R15 100 Ω
R19 15K
Q4 2N1185
Q5 2N1185
MAX OUTPUT VOLTAGE
CR12 IN2622
R22 4.7K
C9 150 µF 50V
C20 100µF 50V
R32 24K
R34 5K 3W
CR11 SC4
R9 300 Ω
R12 10 Ω
R16 100 Ω 2W
M1 0-15 AMPS
R17 1Ω 50W
R18 0.2Ω 25W
C12 20,000 µF 10V
MAX CURRENT ADJUST
Q10-1 2N1542
R37-1 0.3Ω 2W
003A-2000
Q10-6 2N1542
R37-6 0.3Ω 2W
Q9 2N1542
R29 4.7K 2W
Q8 2N652
R28 27K 2W
R30 1 MEG
M2 0-40V
C10 5000 µF 50V
C11 50 µF 50V
R35 33 Ω
J2
J3
REMOTE SENSING TERMINALS
J7 - OUTPUT
003A-0099
J8 + OUTPUT
R36 33 Ω
J4
J5
REMOTE SENSING TERMINALS
J6
J9
GRD
3. ALL RESISTORS 1/2 WATT ± 5 %
2. T1, R7, & R27 ARE MECHANICALLY GANGED
1. THIS DWG SUPPLIED FOR THE OPERATION & MAINT OF BEHLMAN-INVAR EQUIP & IS NOT TO BE OTHER WISE USED OR REPRODUCED W/OUT THE WRITTEN CONSENT OF BEHLMAN-INVAR ELECTRONICS CORP.
NOTES: UNLESS OTHERWISE SPECIFIED
DO NOT SCALE DRAWING
LIST OF MATERIAL
SCHEMATIC
TPA-10
BEHLMAN INVAR
ELECTRONICS CORP.
SANTA MONICA CALIFORNIA
003A-0099
D

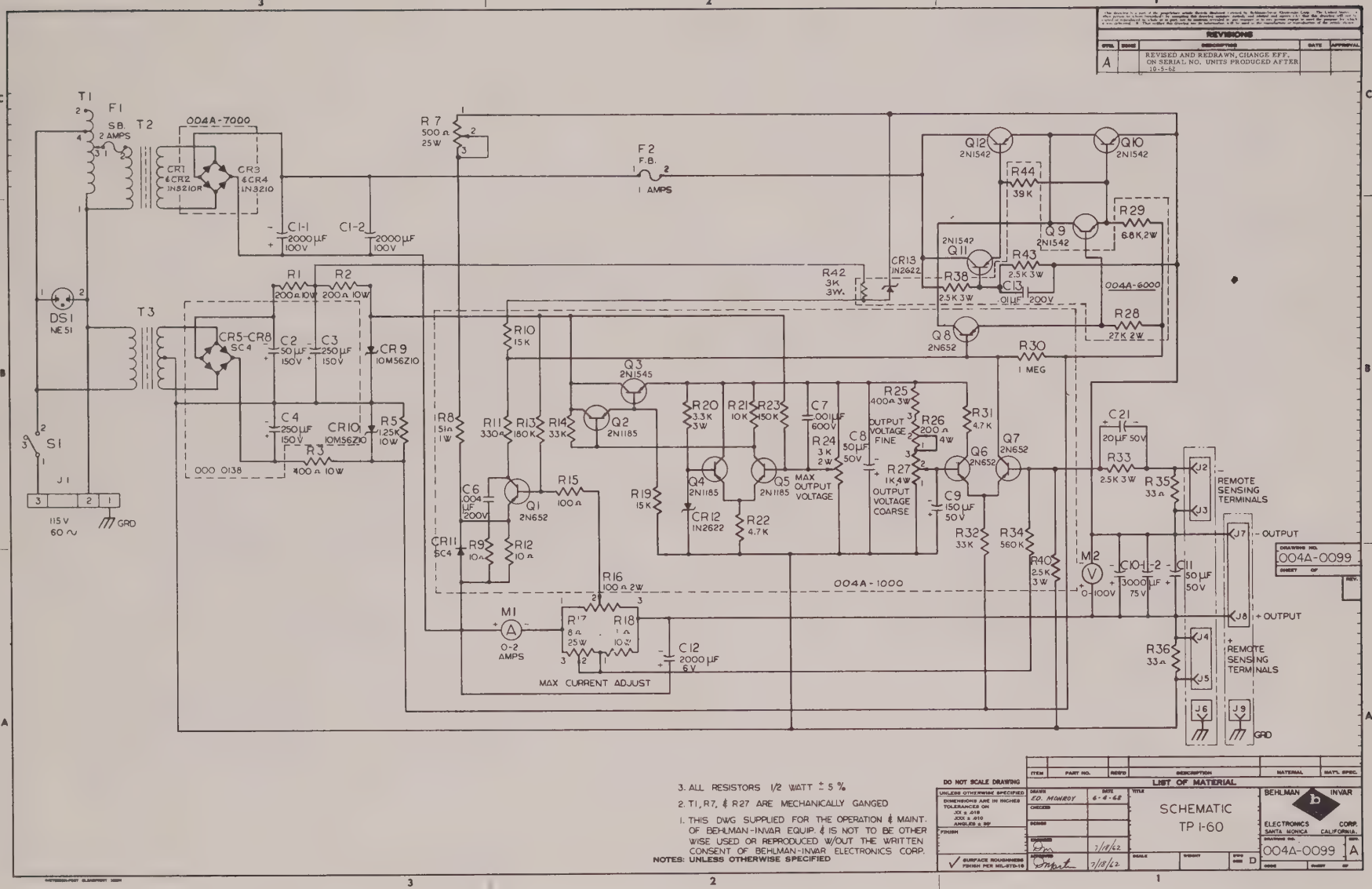


3. ALL RESISTORS 1/2 WATT ± 10 %.
2. T1, R7, & R27 ARE MECHANICALLY LINKED.
1. THIS DWG SUPPLIED FOR THE OPERATION & MAINTENANCE OF INVAR EQUIPMENT AND IS NOT TO BE OTHERWISE USED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF THE INVAR ELECTRONICS CORP.

NOTES: UNLESS OTHERWISE SPECIFIED

DRAWN F.J.LANG JR	DATE 10-10-60	TITLE	BEHLMAN INVAR	
CHECKED		SCHEMATIC TP 15	ELECTRONICS CORP. SANTA MONICA CALIFORNIA	
DESIGN			DRAWING NO. 006-0099	REV. G
ENGINEER Ellert	4/20/61	SCALE NONE	DWG SIZE D	CODE SHEET 1 OF 1
APPROVED				


REVISIONS
SYM. ZONE DESCRIPTION DATE APP.
A CHANGED PER E.O. NO. 192 6-3-61
B CHANGED PER E.O. NO. 194 & 198 6-6-61
C CHANGED PER E.C.O. NO. 304 8-4-61
D CHANGED PER E.C.O. NO. 419 11-15-61
E CHANGED PER E.C.O. NO. 593 3-23-62
F CHANGED PER E.C.O. NO. 663 & 921 7-3-62
T1
F1 20 AMP
T2
CR1-CR4 1N1184A
CH THRU CH6 5000μF 75V EACH
F2 30 AMP
R7 300Ω 5W
DS1 NE51
BI-1 BI-2
S1
J1 115V 60Hz GRD
T3
CR5-CR8 SC-4
R1 200Ω 10W
R2 200Ω 10W
C2 50μF 150V
C3 250μF 150V
CR9 10MS6Z10
C4 250μF 150V
CR10 10MS6Z10
R5 1.2K 10W
R3 400Ω 10W
R10 33K
R8 51Ω 1W
R11 330Ω
R13 180K
R14 33K
Q2 2N652
Q3 2N1547
R20 3.5K 3W
R21 10K
R23 150K
C7 .001μF
R24 3K 2W
C8 50μF 50V
R25 25Ω 5W OUTPUT VOLTAGE FINE
R26 200Ω 4W
R27 1K 5W OUTPUT VOLTAGE COARSE
C9 50μF 50V
R31 4.7K
Q4 2N652
Q5 2N652 MAXIMUM OUTPUT VOLTAGE
Q6 2N652
Q7 2N652
R33 30Ω 3W
CR12 1N2622
R22 4.7K
R19 15K
R15 100Ω
Q1 2N652
C6 .02μF 200V
CR11 SC-4
R9 510Ω
R12 10Ω
R17 1000Ω 4W MAXIMUM CURRENT ADJUST
R16 200Ω 2W
R6 200Ω 3W
M1 0-40 AMPS
R18-1 .1Ω 50W
R18-2 .1Ω 50W
C12
Q10-1 2N1547
Q10-20 2N1547
R37-1 3Ω 2W
R37-20 3Ω 2W
THRU
Q9-1&2 2N1547
R29 3K 2W
Q8 2N652
R28 27K 2W
R30 220K
R35 33Ω
R36 33Ω
R32 33K
R34 5.6K 3W
M2 0-40 VOLTS
C10-1 THRU C10-6 5000μF 50V EACH
C11 50μF 50V
- REMOTE SENSING TERMINALS
- OUTPUT
+ OUTPUT
+ REMOTE SENSING TERMINALS
GRD
DRAWING NO. 009-0099 SHEET 1 OF 1 REV. F
3. ALL RESISTORS 1/2 WATT ± 10 %.
2. T1, R7, & R27 ARE MECHANICALLY LINKED.
1. THIS DWG SUPPLIED FOR THE OPERATION & MAINTENANCE OF INVAR EQUIPMENT AND IS NOT TO BE OTHERWISE USED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF THE INVAR ELECTRONICS CORP.
NOTES: UNLESS OTHERWISE SPECIFIED
DRAWN F. J. LANG JR. 11-10-60
CHECKED 11-10-60
DESIGN
ENGINEER 11-10-60
APPROVED
TITLE SCHEMATIC TP 30
SCALE NONE DWG SIZE D
INVAR ELECTRONICS CORP. PASADENA, CALIFORNIA
DRAWING NO. 009-0099 REV. F
CODE SHEET 1 OF 1



3. ALL RESISTORS 1/2 WATT ± 5 %

2. T1, R7, & R27 ARE MECHANICALLY GANGED

1. THIS DWG SUPPLIED FOR THE OPERATION & MAINT. OF BEHLMAN-INVAR EQUIP. & IS NOT TO BE OTHER WISE USED OR REPRODUCED W/OUT THE WRITTEN CONSENT OF BEHLMAN-INVAR ELECTRONICS CORP.

NOTES: UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
XX ± .010
XXX ± .010
ANGLES ± 30'
FINISH
SURFACE ROUGHNESS FINISH PER MIL-STD-10

ITEM	PART NO.	REQ'D	DESCRIPTION	MATERIAL	MAT'L SPEC.

LIST OF MATERIAL

DRAWN	ED. MONROY	DATE 6-4-62
CHECKED		
DESIGNED		
ENGINEER		7/18/62
APPROVED		7/18/62

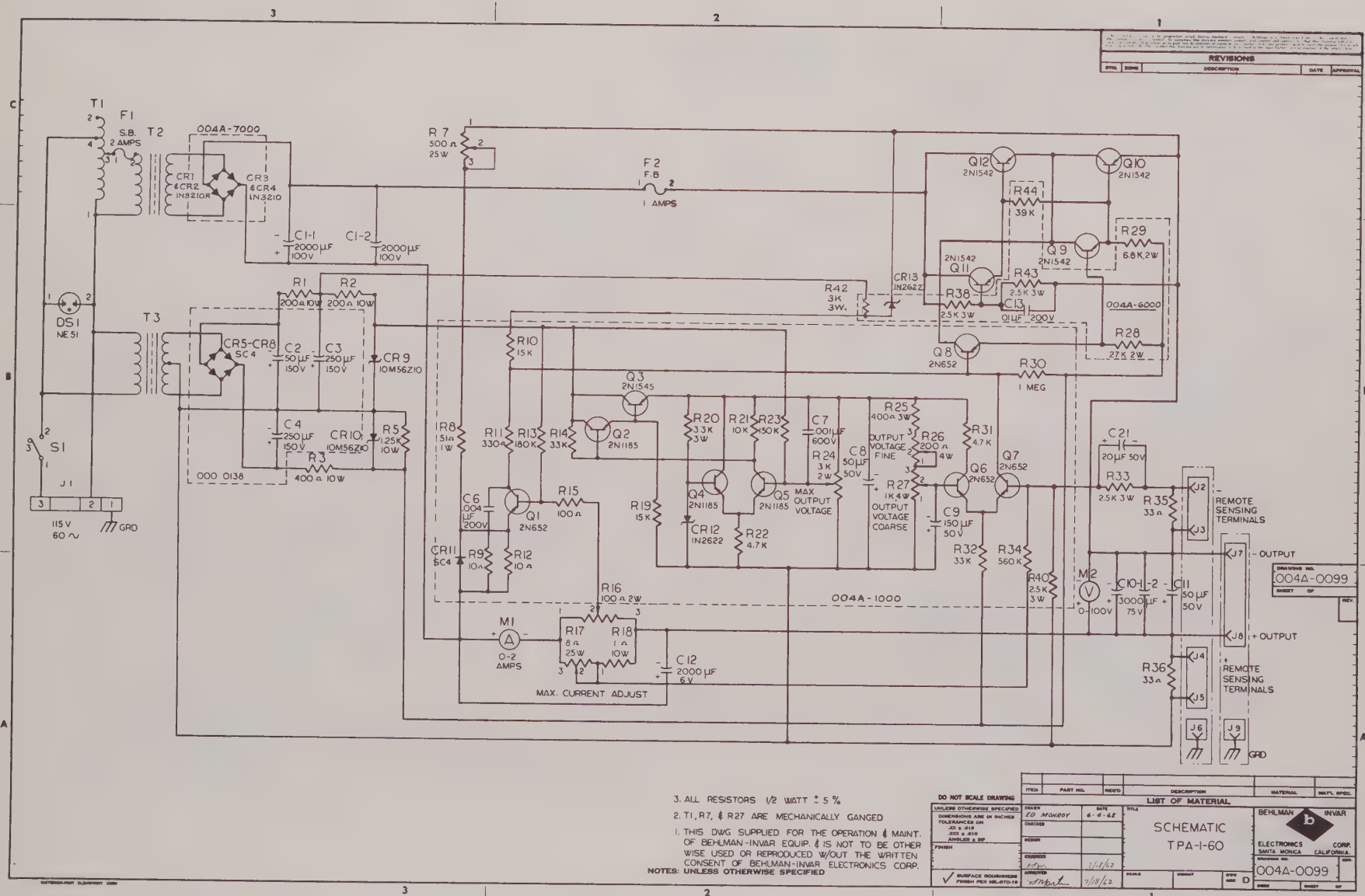
TITLE: SCHEMATIC TP 1-60

SCALE | WEIGHT | SIZE D

BEHLMAN INVAR
ELECTRONICS CORP.
SANTA MONICA CALIFORNIA

DRAWING NO. 004A-0099 REV. A

SHEET OF



REVISIONS

SYM.	ZONE	DESCRIPTION	DATE	APPROVAL

3. ALL RESISTORS 1/2 WATT ± 5 %
2. T1, R7, & R27 ARE MECHANICALLY GANGED
1. THIS DWG SUPPLIED FOR THE OPERATION & MAINT. OF BEHLMAN-INVAR EQUIP. & IS NOT TO BE OTHER WISE USED OR REPRODUCED W/OUT THE WRITTEN CONSENT OF BEHLMAN-INVAR ELECTRONICS CORP.

NOTES: UNLESS OTHERWISE SPECIFIED

DO NOT SCALE DRAWING

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
.XX ± .010
.XXX ± .010
ANGLES ± 30'
FINISH

SURFACE ROUGHNESS FINISH PER MIL-STD-10

DRAWN	ED MONROY	6-4-62
CHECKED		
DESIGN		
ENGINEER		
APPROVED		7/18/62
		7/18/62

LIST OF MATERIAL

ITEM	PART NO.	REQ'D	DESCRIPTION	MATERIAL	MAT'L SPEC.

TITLE
SCHEMATIC
TPA-1-60

SCALE

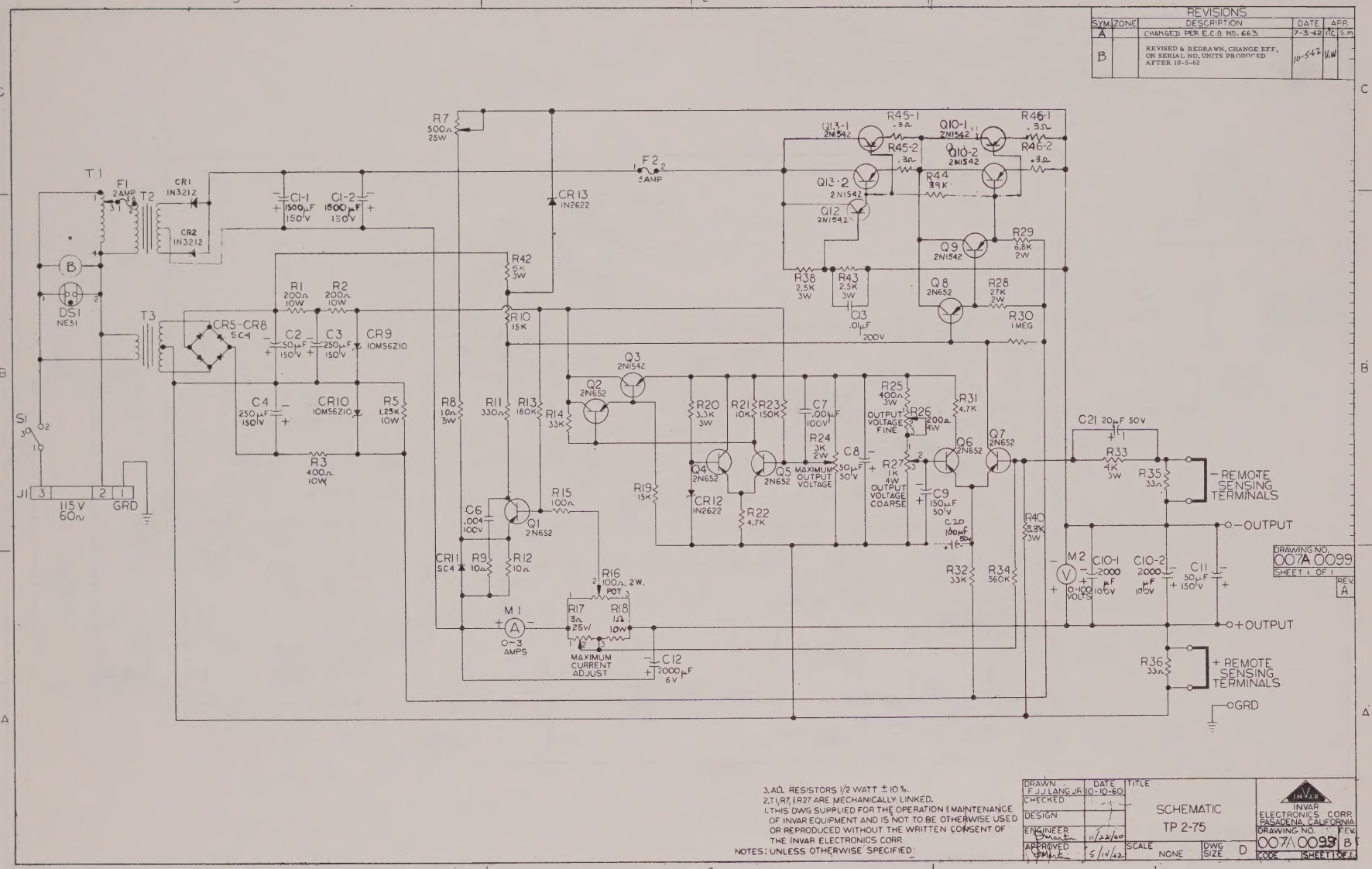
SIZE D

BEHLMAN INVAR
ELECTRONICS CORP.
SANTA MONICA CALIFORNIA

DRAWING NO.
004A-0099

SHEET OF

REV.

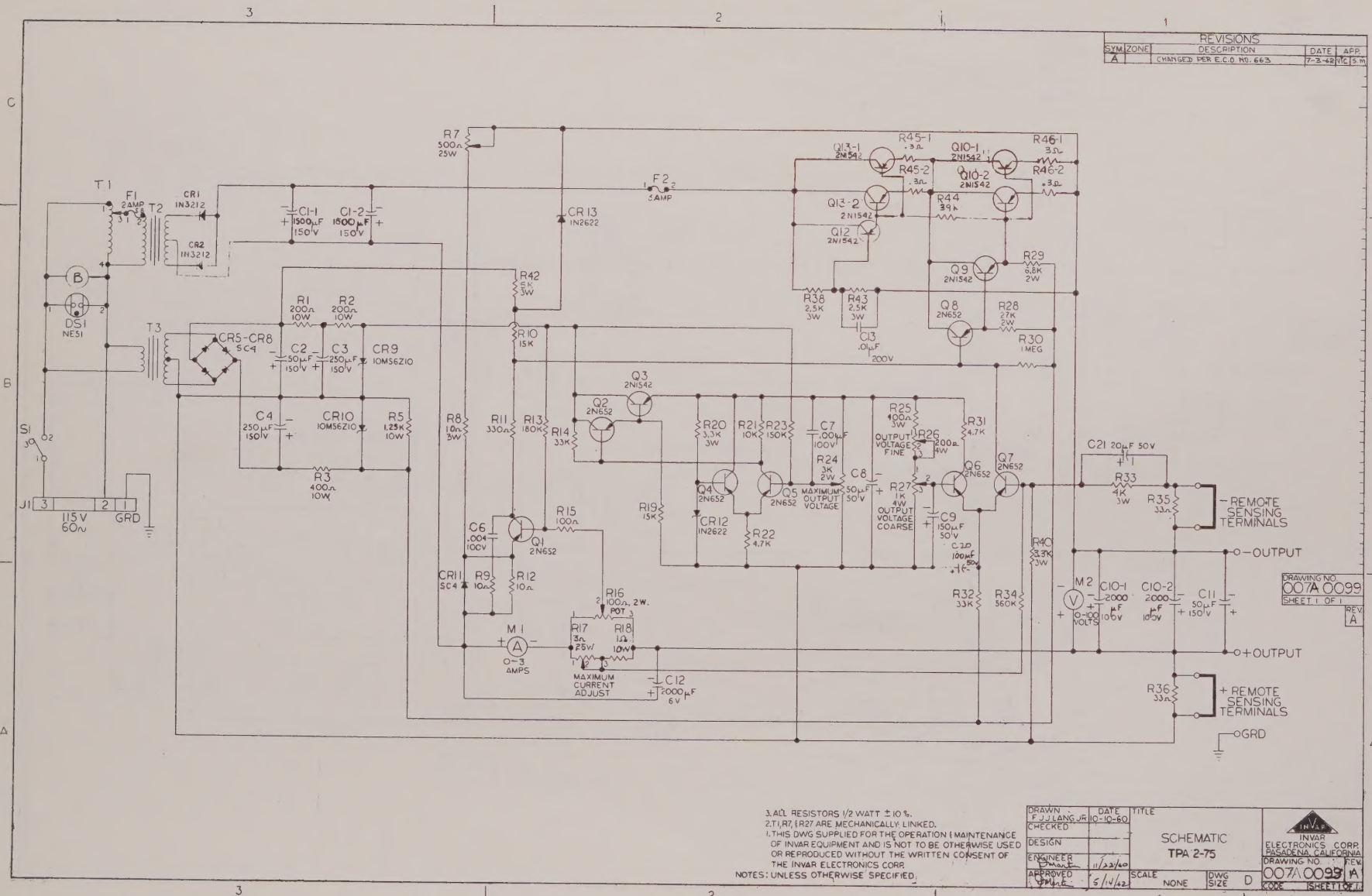


REVISIONS					
SYM	ZONE	DESCRIPTION	DATE	APP.	
A		CHANGED PER E.C.O. NO. 663	7-3-62	J.C.	S.M.
B		REVISED & REDRAWN, CHANGE EFF. ON SERIAL NO. UNITS PRODUCED AFTER 10-5-62	10-5-62	W.W.	

DRAWING NO. 007A 0099
SHEET 1 OF 1
REV. A

NOTES: UNLESS OTHERWISE SPECIFIED:
1. THIS DWG SUPPLIED FOR THE OPERATION & MAINTENANCE OF INVAR EQUIPMENT AND IS NOT TO BE OTHERWISE USED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF THE INVAR ELECTRONICS CORP.
2. T1, R7, & R27 ARE MECHANICALLY LINKED.
3. ALL RESISTORS 1/2 WATT ± 10 %.

DRAWN F.J.J. LANG JR.	DATE 10-10-60	TITLE	INVAR ELECTRONICS CORP. PASADENA, CALIFORNIA
CHECKED		SCHEMATIC TP 2-75	DRAWING NO. 007A 0099 REV. B
DESIGN			
ENGINEER	11/22/60		
APPROVED	5/14/62	SCALE NONE	DWG SIZE D
			CODE SHEET 1 OF 1


REVISIONS
SYM ZONE DESCRIPTION DATE APP
A CHANGED PER E.C.O. NO. 663 7-3-62 MC S.M
T1
F1 2AMP
T2
CR1 IN3212
CR2 IN3212
CI-1 1500µF 150V
CI-2 1500µF 150V
CR13 IN2622
F2 5AMP
R7 500Ω 25W
R42 5K 3W
R10 15K
R1 200Ω 10W
R2 200Ω 10W
T3
CR5-CR8 SC9
C2 50µF 150V
C3 250µF 150V
CR9 10MS6Z10
C4 250µF 150V
CR10 10MS6Z10
R5 1.25K 10W
R3 400Ω 10W
S1
J1
115V 60Ω
GRD
DS1 NES1
R8 10Ω 3W
R11 330Ω
R13 180K
R14 33K
Q3 2N1542
Q2 2N652
R20 3.3K 3W
R21 10K
R23 150K
C7 .001µF 100V
R24 3K 2W
C8 50µF 50V
MAXIMUM OUTPUT VOLTAGE
R25 100Ω 3W OUTPUT VOLTAGE FINE
R26 200Ω 4W
R27 1K 4W OUTPUT VOLTAGE COARSE
R31 4.7K
Q4 2N652
Q5 2N652
Q6 2N652
Q7 2N652
CR12 IN2622
R22 4.7K
R19 15K
C6 .004 100V
Q1 2N652
R15 100Ω
CR11 SC4
R9 10Ω
R12 10Ω
R16 100Ω 2W POT
R17 3Ω 25W
R18 1Ω 10W
MAXIMUM CURRENT ADJUST
M1 0-3 AMPS
C12 2000µF 6V
Q13-1 2N1542
Q13-2 2N1542
Q12 2N1542
R45-1 .3Ω
R45-2 .3Ω
Q10-1 2N1542
Q10-2 2N1542
R46-1 3Ω
R46-2 .3Ω
R44 39K
R38 2.5K 3W
R43 2.5K 3W
C13 .01µF 200V
Q9 2N1542
R29 6.8K 2W
Q8 2N652
R28 27K 2W
R30 1MEG
C21 20µF 50V
R33 4K 3W
R35 33Ω
R40 3.3K 3W
R32 33K
R34 560K
M2 0-100 VOLTS
C10-1 2000µF 10V
C10-2 2000µF 10V
C11 50µF 150V
C20 100µF 50V
R36 33Ω
- REMOTE SENSING TERMINALS
-OUTPUT
+OUTPUT
+ REMOTE SENSING TERMINALS
GRD
DRAWING NO. 007A0099
SHEET 1 OF 1
REV. A
3. ALL RESISTORS 1/2 WATT ± 10%.
2. T1, R7, & R27 ARE MECHANICALLY LINKED.
1. THIS DWG SUPPLIED FOR THE OPERATION & MAINTENANCE OF INVAR EQUIPMENT AND IS NOT TO BE OTHERWISE USED OR REPRODUCED WITHOUT THE WRITTEN CONSENT OF THE INVAR ELECTRONICS CORP.
NOTES: UNLESS OTHERWISE SPECIFIED.
DRAWN F.J.J. LANG JR DATE 10-10-60
CHECKED
DESIGN
ENGINEER 11/22/60
APPROVED 5/14/62
TITLE SCHEMATIC TPA 2-75
SCALE NONE DWG SIZE D
INVAR ELECTRONICS CORP. PASADENA, CALIFORNIA
DRAWING NO. 007A0099 REV. A
CODE SHEET 1 OF 1

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